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Weed Suppressive Groundcovers A More Attractive and Effective Way to Manage Weeds

Recent meetings of the New York State Landscape Horticulture Program Committee have led to the development of focus areas for future research and extension emphasis in turfgrass and landscape settings in New York. The statewide program committee has both landscape and turf divisions with representation from academics at Cornell University, key stakeholders and county-based extension personnel. The development of alternative pest management strategies for weed, insect and pathogen pests of turfgrass and landscape plants, as well as environmental preservation of greenspace across New York were identified as key priorities in 2001. Greater understanding of the plant's interaction with its environment, including soil rhizosphere ecology, and the impact of stress on plant growth were also identified as important research priorities. Given this increased emphasis on alternative pest management and environmental preservation, our research and extension programs have expanded to address this need. 

Increased Greenscapes

In the past 10 years the landscape industry has seen a rapid increase in spending by the homeowner and commercial landscaper on plant material selections, installation and maintenance. The green industry as a whole has nearly doubled in some areas of New York and the U.S., with recent expansion in numbers of acres in greenscape, and the completion of new golf courses, parks, athletic fields, and private landscape projects. In terms of turfgrass, the U.S. maintains over 25 million acres of turf, with over 2 million acres in New York alone.

Weed management in turf and landscapes has been identified as one of the most critical pest control issues in turf and landscape settings. This issue recognizes the time and amount of herbicide applied to these areas for control of annual and perennial weeds and the strong emphasis on aesthetic appeal. Complicating this issue is the fact that herbicide application in residential and public areas has become more and more controversial. Exposure of adults, children and animals to pesticides is of key concern, as well as runoff due to excessive rainfall or misapplication, or residual activity in local or municipal mulches. Most recently,

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DOT has initiated a program to investigate alternatives to herbicides for vegetation management. Effective alternative strategies could result in significant reductions in herbicide application and less environmental impact in the long term.

The herbicide alternative product BurnOut, and the clove oil derivatives suppressed weeds initially to some extent, but regrowth was soon evident after application. Corn gluten meal was found to be expensive to apply given its limited weed suppression, which was similar to that provided by application of less expensive synthetic fertilizers containing nitrogen.

the American Lymphoma Society has reported that higher incidence of usage of 2,4 D was associated with increased incidence of lymphoma in humans. Undoubtedly, further studies and restrictions in use of 2,4 D, the major broadleaf weed control herbicide in turf, are likely as a result of these findings.

State DOT Activities

Besides private and public agencies and stakeholders who maintain turf and landscapes, the New York State Department of Transportation (DOT) currently manages vegetation growth along rights-of-way (ROW) in order to provide adequate sight distances, visibility of signs and guiderails, and prevention of deadly fixed objects along highways. DOT has adopted an integrated vegetation management program which includes prevention, monitoring and control methods as key elements for vegetation management. The establishment of an appropriate vegetation cover which can be maintained with periodic mowing is the preferred technique currently used within the ROW where mowing can be performed. For vegetation under the guiderail and around signs and on slopes where mowing cannot be performed, periodic herbicide treatments have been traditionally used for management of vegetation.

As formally stated in DOT's Environmental Initiative, the DOT has an obligation and responsibility to the people of New York to enhance, protect and improve the environment. Declining resources and an increased interest in management strategies for vegetation with limited environmental impact have also reinforced the need for this agency to examine alternative strategies for vegetation management along New York's highway system. DOT has initiated a program to investigate alternatives to herbicides for vegetation management. Effective alternative strategies could result in significant reductions in herbicide application and less environmental impact in the long term.

Alternative Strategies

To address these needs, recent studies in managed turf settings and along roadsides have investigated the use of alternatives to herbicides for vegetation and weed management. Demonstration projects were designed along roadsides by DOT to evaluate the use of mulch mats made from recycled tires, wildflower mixes to

provide low-growing ground covers, and weed fabric mulches. In addition, organic herbicide products including BurnOut—a mixture of acetic acid and lemon juice—clove oil derivatives and corn gluten meal based products were evaluated by extension personnel and the DOT for turf weed and vegetation control. Standard application rates were tested with comparisons to standard herbicide treatments, including Round Up and selected preemergent products.

Studies have also evaluated the use of Alamo and Polecat mowers for vegetation management under guiderails. The general findings of the first two studies indicated that mulch materials in the landscape and along roadsides for weed suppression were expensive, not necessarily effective in suppressing weeds over the long term, and were labor intensive with respect to installation. The herbicide alternative product BurnOut, and the clove oil derivatives suppressed weeds initially to some extent, but regrowth was soon evident after application. Corn gluten meal was found to be expensive to apply given its limited weed suppression, which was similar to that provided by application of less expensive synthetic fertilizers containing nitrogen. The use of alternative mowing strategies and more frequent mowing offered some promise for weed management in turf and under guiderails but involved expensive equipment purchase and additional labor expenses.

So what other non-chemical alternatives might we suggest for use in landscapes and along roadsides? Let's consider the plant material we establish in landscape, turf and roadside settings. Besides turf, the diversity of new ornamental plant materials now available, including groundcovers, is enormous. Given this diversity, the fact that turfgrass may not be the best plant material selection in shady, moist or droughty locations, and the interest in minimizing inputs for pest management, the investigation of new groundcover selections for the landscape has attracted our attention.

In collaboration with Dr. Andy Senesac at Long Island Horticulture Research and Extension Center in Riverhead NY, we have established extensive field trials in Ithaca and Riverhead to evaluate a diverse collection of herbaceous ornamental groundcovers, turfgrasses and native species. Our goals were to select materials which were easily established, required low maintenance and were able



to overwinter in the Northeast. In addition, the selection of materials which were weed suppressive and resistant to insects, disease and mammalian pests was of critical importance for long-term maintenance ease.

Certain plant selections may offer strong potential for vegetation suppression along NY roadsides, especially if one considers those groundcovers which are easily maintained and stress tolerant. Many groundcover selections have dense low-growing foliage which prevents light penetration at the soil surface and provides for increased competition with weed seedlings for space, light, fertility, and water. Certain ground covers also inhibit weed growth by releasing natural herbicides or allelochemicals from foliage or living root systems, similar to the suppressive effects of the black walnut, for example. We are currently selecting for materials that are both highly competitive and possibly allelopathic, in an attempt to develop recommendations and an interactive website for stakeholders who want aesthetically pleasing, pest resistant selections for landscapes, golf courses, roadsides or other uses.

Suppressive Groundcovers

Weed suppressive groundcovers have been shown to be effective for annual weed suppression in orchards, vineyards, nurseries, and vegetable fields. Plants which produce large quantities

of biologically active secondary products called allelochemicals are likely to exhibit resistance to insects, diseases, weeds, or other predators because of their presence within the plant. These allelochemicals are secondary products that are chemically diverse and appear to play a strong role in plant protection from an evolutionary standpoint.

Groundcovers represent an exceptionally diverse collection of higher plants that possess larger quantities of secondary products than many cultivated edible plants, where selective breeding for palatability has resulted in lesser quantities or the total absence of these compounds. Groundcovers such as *Vinca*, *Pachysandra* and *Arctostaphyllum* spp. are highly weed suppressive, due to their dense canopy that may prevent light from reaching the soil surface and stimulating weed seed germination. However, these species also contain secondary products of unique structure and activity. For example, vinca, or periwinkle, produces large amounts of vincristine, a potent inhibitor of leukemia in children. Vinca is raised commercially for extraction and collection of vincristine. *Pachysandra* contains a group of saponins that were used for making soap, but are also potent plant growth and germination inhibitors. *Arctostaphyllum*, the common bearberry, contains a group of complex terpenoids that exhibit inhibitory activity against weeds and insects.

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According to Paul Curtis of the Department of Natural Resources at Cornell University, relatively few studies have been performed with common groundcovers to evaluate their ability to repel mammalian pests. Recent studies with vinca and pachysandra, however, have shown that bioassays testing the feeding activity of these pests can be effectively designed and are highly correlated with their palatability to deer.

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Three successive years of field studies at the Turfgrass Research Center in Ithaca NY have shown that certain cultivars of fine fescue are more weed suppressive than others. How exactly do they suppressive weeds? This is the subject of our current research. Some cultivars show strong suppression by their dense growth habit and also through the production of bioactive root exudates from living roots of fine fescues.

Our studies in 2000 and 2001 with herbaceous ornamental-type groundcovers have shown that there are certain groundcovers which exhibit strong aesthetic appeal, resistance to droughty conditions, ability to overwinter well in several climatic regions and also strong weed suppressive abilities.

In addition, there are numerous cultivated and native grass species which also have weed suppressive characteristics and may offer appeal in turf and landscape plantings. Certain selections or cultivars of perennial ryegrass, buffalograss and fine or coarse fescues appear to be most promising as low maintenance turfs which offer weed suppressive characteristics. These species and many others offer interesting opportunities for aesthetic appeal in the landscape along with resistance to key pests.

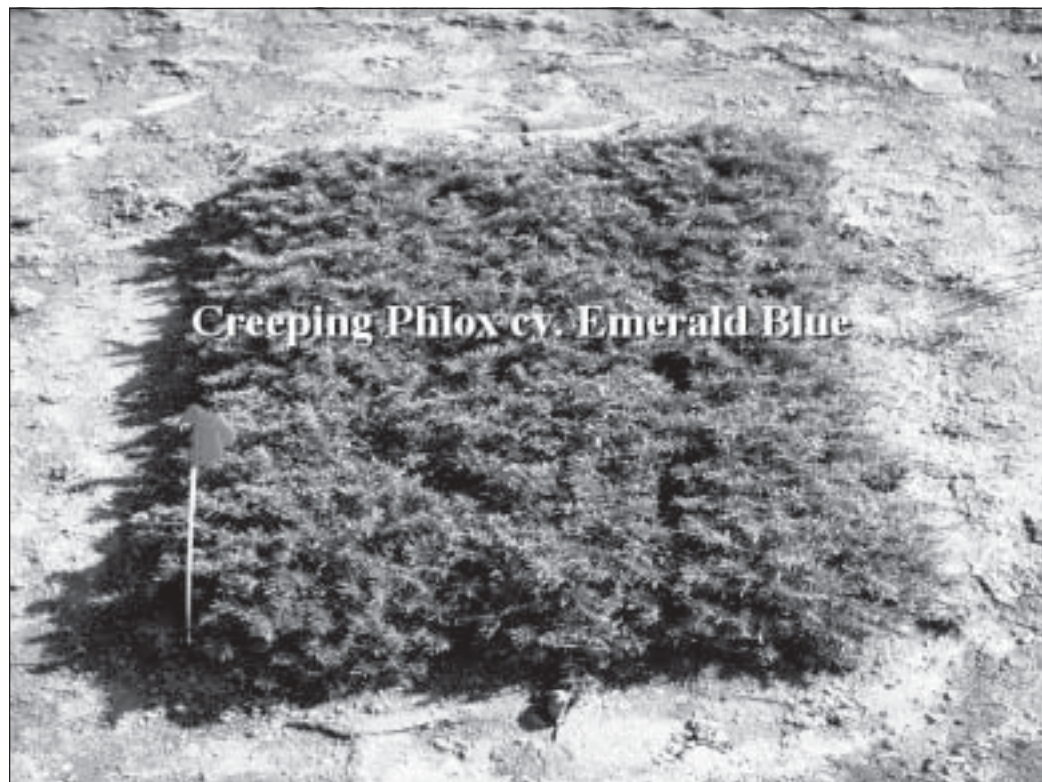
In the landscape as well as naturalized areas, groundcovers serve a variety of functions. They have been recognized to serve as a potential means of protection against soil erosion; their foliage and flowers may add to the aesthetic value, function and form of the landscape; and they may also serve to suppress weeds that grow in the same spatial area as the groundcover itself. As mentioned previously, many of these groundcovers, grasses or native species have never been investigated for their ability to suppress weeds, or the presence of secondary products associated with resistance to insects, diseases or mammalian species.

If one establishes a group of groundcovers in the Northeastern U.S. either in the landscape or along roadsides for weed suppression, it will be imperative that these materials do not attract mammalian pests including voles, mice

and especially deer. According to Paul Curtis of the Department of Natural Resources at Cornell University, relatively few studies have been performed with common groundcovers to evaluate their ability to repel mammalian pests. Recent studies with vinca and pachysandra, however, have shown that bioassays testing the feeding activity of these pests can be effectively designed and are highly correlated with their palatability to deer. The presence of unique chemicals in their foliage contributes strongly to the groundcover's ability to repel these mammals or be utilized as a food source.

Suppressive Fescues

Recently, our own studies have shown that creeping or fine fescues (*Festuca rubra* or *Festuca ovina* spp.) for use as turfgrasses in lawns, athletic fields or even golf courses can also be exceptionally weed suppressive. Three successive years of field studies at the Turfgrass Research Center in Ithaca NY have shown that certain cultivars of fine fescue are more weed suppressive than others. How exactly do they suppressive weeds? This is the subject of our current research. Some cultivars show strong suppression by their dense growth habit and also through the production of bioactive root exudates from living roots of fine fescues. Root inhibitors are exuded into the rhizosphere from



the actively growing living roots. We can collect this exudate from fescue growing in agar or sand growth media in laboratory bioassays. The exudate contains about 20 diverse chemicals which are now being structurally characterized. The purified exudate shows potent activity as a seed germination inhibitor of a variety of weed and crop species. Past studies have shown that other coarse fescues are also allelopathic and inhibit the growth of weeds and woody species. Many are used as weed suppressive groundcovers in orchards or vineyards in the western U.S.

Our studies in 2000 and 2001 with herbaceous ornamental-type groundcovers have shown that there are certain groundcovers which exhibit strong aesthetic appeal, resistance to droughty conditions, ability to overwinter well in several climatic regions and also strong weed suppressive abilities. We plan to conduct these studies over at least the next 5 years to focus upon a diverse collection of attractive species which would be useful in both landscape and roadside settings for weed suppression.

Several species that have shown great promise in our first year of trials in both Ithaca and Riverhead include several species of sedum, creeping phlox, blue lymegrass, ladies mantle, solidago or ornamental goldenrod, and creeping thyme. Other species have proven less tolerant of the New York climate, and less able to suppress weeds. Species that performed poorly

for a variety of reasons included several species of creeping hydrangea, phlox, fragaria (ornamental strawberry), and houstonia.

Other less well-known materials are now under evaluation for use in a variety of settings across the state. Eventually, we will be conducting on-site highway trials in several settings across the state to predict their ability to suppress weeds along New York roadsides. We have also established a collection of hardy native species that may offer the same interesting characteristics. While ornamentals are generally established by either cuttings or direct seeding, native species are generally established only by direct seeding. One challenge we will face is to develop methodology to enhance seed germination and establishment of these small-seeded natives in less than favorable planting locations.

Within 2 years, we plan to establish an attractive website containing color pictures of each groundcover evaluated with recommendations on establishment and maintenance. Ratings on their individual ability to suppress weeds and resist pest infestation will also be featured. Based on your own landscaping experience, any suggestions you may have for interesting materials to include in our continuing studies would be appreciated. Don't forget that it will be possible to see our field trials in Ithaca and Riverhead locations at Cornell's turfgrass and ornamental Field Day.

Leslie Weston

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